Water on the Moon and the Apollo Programme

SPACE enthusiasts must be regretting that the report of what may be molecules of water emanating from the surface of the Moon did not come sooner. It is much too late to save the two Apollo flights that were cut from the programme last year amid uproar from lunar scientists. And it is now unlikely that the second of the last two Apollo flights, Apollo 17, will also be docked from the programme, contrary to what the pessimists were saying a year ago. But the hypothetical water has surfaced just in time to participate in the debate on the need or otherwise to continue the exploration of the Moon after Apollo 17.

In these circumstances the announcement by Dr John Freeman of Rice University, Houston, was bound to be cheering news for the space zealots. To them, the approximately two pints of water which are estimated to have been responsible for the observations imply that the Moon may contain some of the basic raw materials that would have to be ferried there if a scientific colony is to be established. It remains to be seen, however, whether Dr Freeman and his colleagues are raising false hopes. The cloud of gas identified as containing water molecules was recognized in data obtained on March 7 by the suprathermal ion detectors left at the sites of the Apollo 12 and 14 landings. The cloud seems to have been triggered by a series of seismic events. But Dr Freeman is reported to have said that although water vapour is the most probable explanation of the readings, any of several less surprising gases such as ammonia, neon or other rare gases could also have been responsible.

On this basis it would be a mistake if the possibility of large amounts of water trapped beneath the lunar surface were to colour the exploration of the Moon in the same way as the possibility of living material on Mars has been a chief consideration in the design of planetary probes. For the present, the outcome of Freeman's announcement will be to focus attention on equipment to be carried on the Apollo 17 flight to examine the electrical properties of the surface layers of the Moon, which could conceivably reveal the layer of subsurface ice or water.

In the long term, however, it would also be risking disappointment to use the hypothetical water as an apologia for the continuation of lunar exploration after Apollo 17. While officials of NASA have been stumping the country for the support which they hope will prevent the shuttle programme from suffering the same fate that befell the supersonic transport, many scientists, inspired by the outcome of the Apollo programme, have been living in the hope of funds for a modest continuation of manned lunar exploration when the Skylab experiment is over in 1973. Even without the equivocal evidence for lunar water there should be no shortage of justifications for, say, the launch of a manned and heavily instrumented Apollo spacecraft into a polar orbit around the Moon.

The view that space research after 1973 should continue to concentrate on the Moon will not go unchallenged. Many people would rather first of all ensure that there is enough money in the scientific budget of NASA to follow up the amazing series of discoveries by the X-ray astronomy satellite. This is why the Space Board of the NAS has given priority to the automatic observatory carrying X-ray and γ-ray equipment and scheduled for launch in 1975, rather than to the Grand Tour probes to the outer planets. Indeed, there are signs that NASA has come to terms with the doubts that have been expressed about the Grand Tour, which also include the difficulty of constructing planetary probes that will have to be an order of magnitude more reliable than the present Mariner series. Studies are under way to see what could be salvaged from the Grand Tour project—once considered essential for NASA's well being in the late nineteen-seventies—if it has to be cancelled.

DNA REPLICATION

Restarting Replication of the Bacterial Chromosome

from our Cell Biology Correspondent

WHEN an episome such as the sex factor F, or a lysogenic bacteriophage, becomes integrated into a bacterial chromosome it is replicated passively along with the rest of the bacterial genome of which it is now part even though F factors and the genomes of lysogenic phages carry genetic determinants capable of controlling and initiating their own independent replication. Apparently these genes which function when the F factors or phages exist in an autonomous state become subordinated to their counterparts in the bacterial chromosome upon integration. But what happens when the phage or episome is integrated into the chromosome of a temperature sensitive mutant bacterium which is unable to initiate the replication of its genome at some nonpermissive temperature? Can the replication machinery of the episome or prophage as it were take over and initiate the replication of the entire bacterial chromosome? The answer to this intriguing question, no doubt much to the gratification of Jacob, Brenner and Cuzin, the postulators of the replicon theory, is that it can.

Earlier this year, Nishimura, Caro and Berg (*J. Mol. Biol.*, **55**, 441; 1971) reported that when an F factor integrates into the chromosome of CRT46 cells—a mutant strain of *Escherichia coli* which is unable to initiate the replication of its DNA at 42° C—the bacteria become Hfr and can replicate their DNA at this temperature. This "integrative suppression" by F factor of the temperature sensitive lesion in CRT46 cells indicates that the entire bacterial chromosome has in effect become part of the F factor replicon.

Now in the latest issue of the *Proceedings of the US National Academy of Sciences* (**68**, 2407; 1971), Lindahl, Hirota and Jacob report that the replication of the *E. coli* chromosome can come under the control of prophage P2 genomes. The Paris group, having found that P2 replicates in CRT46 cells